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ABSTRACT

This study explored some ways that cognitive style (different individual patterns of perceiving, memorizing, organizing and utilizing stimuli) might influence intellectual achievements. It was specifically concerned with cognitive tempo--the individual's tendency to be either slow and accurate (reflective) or fast and inaccurate (impulsive). A number of hypotheses concerning these two cognitive tempos and their relationship to presentation mode, instructions, and grade were advanced and tested. Subjects were 82 elementary school students. They were given pattern-matching and concept-formation tasks. The results of the study did not support the expectations. None of the principal hypotheses concerning the relationship of the cognitive style dimension of reflectivity-impulsivity to performance on the experimental task were substantiated. The sole significant finding indicated that a selection paradigm yielded fewer average trials to criterion than a reception mode. It appears that by the time an individual is in the fourth grade, he/she is more proficient at forming concepts when allowed to freely choose the concept instances than when the experimenter presents these instances. No specific relationship of this variable with cognitive style was found, however. (Author/BP)

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Effects of presentation mode, instructions, grade and cognitive style on a concept formation task

Janet L. Sola

Persistent individual differences in behavior and thought can be seen in the patterns of perceiving, memorizing, organizing, and utilizing stimuli encountered. These are a few aspects of cognitive style, which Bourne, Ekstrand, and Dominowski (1971) suggest will influence the attainment of intellectual goals. In any educational or learning situation these dispositions would partially determine the depth of learning, the ease of concept acquisition, and possibly the effectiveness of an instructional method. These styles may be considered general enough to characterize much of an individual's activity, and thus be distinguishing features of one's behavior.

More specifically, one disposition which has ramifications for learning is cognitive tempo, the individual's tendency to be either slow and accurate (reflective) or fast and inaccurate (impulsive). An individual may reflect on the quality of his/her cognitive products, delaying an immediate response or judgment. Alternatively, this response is impulsively generated, accepted, and emitted without refraction (Kagan, 1965). The focus is upon error rate and on the length of time a person takes to respond in a situation that involves a degree of uncertainty.

In numerous studies visual matching tasks a negative correlation, averaging -.55, has been found between the average response time and total number of errors (Kagan and Messer, 1975; Ault, Mitchell, and Hartmann, 1976; Sola and Phye, 1976). Fast/inaccurate (impulsive) individuals have on the average, short response latencies for each item and make numerous mistakes on the task overall. Those displaying opposite tendencies are considered slow/accurate (reflective). It has

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been suggested that impulsives act on the first hypothesis generated without considering its adequacy while reflectives take more time to analyze the situation and the correctness of their tentative solutions.

Recently, problem-solving strategies of individuals with varying cognitive styles have been investigated. McKinney (1973) presented impulsive and reflective second graders a matrix solution task, requiring that they determine the correct object (flowers) through "yes" and "no" questions. Findings indicated that reflectives used a well developed strategy (focusing) more frequently and required fewer trials than did impulsives. These latter subjects tended to obtain information in a trial-and-error manner or through scanning, generally a less efficient strategy than focusing. In a follow-up study, McKinney (1975) presented 7, 9, and 11 year old reflectives and impulsives five problem solving tasks. At the seven year old level, reflectives were more systematic than impulsives at testing hypotheses, utilizing a focusing approach more frequently on three of the five tasks. Of interest was the indication that reflectives showed continued task improvement between nine and eleven years of age on a pattern-matching task and a picture problem, while impulsives showed minimal developmental gains. Performance of nine year olds was similar, regardless of cognitive tempo, but by eleven years of age reflectives displayed a significant increase in focusing behavior while impulsives continued to use a mixed-strategies approaches.

Therefore, it has been suggested that reflectives and impulsives differ in the use of time-consuming strategies, potentially affecting the efficiency of concept formation. In the present study, it was hypothesized that an optimal strategy (focusing) is developed earlier

by reflectives than by impuslives, as evidenced in fewer trials to criterion. Reflective fourth graders and impulsive sixth graders were predicted to perform comparably in a concept formation task involving geometric figures. Hypotheses also suggested that a condition in which concept examples are presented to a subject in an optimal manner (reception mode) would be more beneficial to those individuals who supposedly do not spontaneously use well-developed strategies (impulsives) than would a selection condition (in which the subject himself chooses the concept examples). This would be expected, also, if impulsives have attentional deficiencies so that a concept formation task demanding more from one's attention (i.e. a selection paradigm) should yield superior performance on the part of those who can direct attention to and scrutinize the task at hand. It was also predicted that those who do not use highly developed strategies (impulsives?) would benefit more from instructions concerning how to use a focusing approach than would those who do (reflectives). Additionally, it was assumed that if this dimension of cognitive style were a generalized characteristic of an individual's behavior, latencies of response on the MFF-task should be related to latencies on an attention task and if deficiencies in attention deployment are characteristic of impulsives, differences in latency on this task were expected for impulsives and reflectives.

Eighty-two subjects were selected from the fourth and sixth grade classes at the Gilbert, Iowa, Community School. Twenty males and 20 females were in the fourth grade sample ($\bar{X}$ = 10.6 years) and 17 males and 25 females were in the sixth grade sample ($\bar{X}$ = 12.6 years). All

fourth and sixth graders in the school were tested, randomly assigned to the experimental groups. Subjects were initially administered Kagan's Matching Familiar Figures (MFF) task and the Attention Diagnostic Method (ADM), and within two weeks were given a concept formation task.

As a measure of attentional failure (Block, J., 1965) the ADM required subjects to locate the numbers 10 through 36, in numerical order and to name the color. Numbers were randomly ordered on a large board, each being painted either red, yellow, black, green, or blue. S would say "10-green, 11-blue, 12-white" and so on. Time to locate each number was recorded. The MFF and ADM were counterbalanced and were individually given. The materials for the concept formation task were 3 X 2 inch cards containing figures which differed in four respects: shape, color, number, and size. Shapes were circles, squares, crosses; one, two or three figures were on each card varying in color -- blue, green, or red. Sizes of the objects varied -- small (1/2"), medium (1"), and large (1 1/2"). Concept cards were arranged in an orderly fashion, being in full view throughout the task. Concepts were conjunctive with two attributes defining each concept (e.g. color and size). Two were then irrelevant (e.g. shape and number). Four conditions of task presentation were: (1) Reception-No Instructions; (2) Reception-Instructions; (3) Selection-No Instructions; (4) Selection-Instructions. The dependent measure obtained was the average number of trials to reach criterion of four consecutive correct responses for the eight concepts presented.

Instead of dichotomizing the continuous variables, MFF latency and error, and losing information and statistical power, a multiple regression procedure was employed allowing error and latency to be analyzed as continuous variables. Also, in place of using these basic variables (MFF latency and error) as predictors of the dependent measure, two linear combinations were developed. The first combination generated, labeled DIFF, was the weighted difference between error and latency scores: $E - \left(\frac{s_E}{s_L}\right)L$.

A high score indicated an individual who responded rapidly yet made mistakes in the process. A low score suggested a slow/accurate style. It was felt that such a linear combination was a more precise, accurate indication of an individual's stylistic orientation than that given by a median split procedure of classification.

The other linear combination generated, termed SUM, was the addition of error and latency scores, $E + \left(\frac{s_E}{s_L}\right)L$. This was considered comparable to the off-quadrants of the traditional dichotomization procedure. Low scores on this combination indicated fast/accurate (competent) performance, while high scores designated slow/inaccuracy (incompetency). This aspect of MFF performance is essentially ignored in the literature and in research on cognitive style. The weighting factor which gave equal contribution to error and latency in the linear combinations also ensured that these two combinations were orthogonal. Thus, an ability dimension (SUM) and a stylistic performance dimension (DIFF) were teased apart and analyzed separately.

A correlation matrix was computed for the predictor variables (presentation mode, instructions, grade, and performance on the MFF

and ADM) and the dependent measure (average number of trials to criterion). The measures significantly correlated with the dependent variable were presentation mode ($r = .29$, $p < .008$) and SUM ($r = .28$, $p < .01$). In the multiple regression analysis which was conducted, mode of presentation of the concept instances was the only variable found to be significant in predicting task performance, $F(1,50) = 4.15$, $p < .05$. The condition in which subjects controlled stimulus choice (selection) yielded fewer trials to criterion than did a reception condition (means were 7.25 and 9.73, respectively). The linear combination labeled SUM approached significance, $F(1,50) = 3.09$, $p < .10$. No other main effects or interactions were significant in this analysis

For those subjects in a selection condition, it was also possible to delineate the strategy used by them when learning the concepts. The number of times a focusing approach was employed over the eight trials was analyzed in a multiple regression analysis. Regardless of the treatment condition, grade level, or cognitive style of the subject, approximately equivalent numbers of focusing approaches were used during concept attainment over the eight concepts. As a final analysis, the relationship between MFF and ADM performance was considered. Results indicated that latencies on the ADM did not correlate with MFF latency, errors of their linear combinations, DIFF or SUM.

The results of the analyses of this study did not support the majority of the predictions initially presented. None of the principle hypotheses concerning the relationship of the cognitive style dimension of reflection-impulsivity (DIFF) to performance on the experimental task were substantiated. The sole significant finding indicated that

a selection paradigm yielded fewer average trials to criterion than a reception mode, paralleling previous findings dealing with adult performance (Hunt, 1965). It appears that by the time an individual is in the fourth grade, he/she is more proficient at forming concepts when allowed to freely choose the concept instances than when the experimenter presents these instances. No specific relationship of this variable with cognitive style was found, however.

Instructions failed to be effective in increasing the use of focusing approaches nor the efficiency of performance. Again cognitive style was not related to this instructional manipulation. A question arises, though, as to the completeness and/or the understandability of these instructions. This must be considered before one eliminates the possibility that instructions with training may be beneficial to performance in a situation where some (impulsives) may not automatically use the most effective strategies. Grade differences did not appear in the problem solving task, as had been found in other developmental studies (McKinney, 1975). No support was given to the hypothesis that a younger individual who could be characterized by the MFF as slow and accurate in orientation would perform on the concept formation task with accuracy similar to a sixth grader who rapidly responds yet is inaccurate. When actual strategies were considered, individuals of a reflective orientation did not display a greater number of focusing approaches than did impulsive subjects.

In general, results of this study did not demonstrate a relationship between cognitive style (reflection-impulsivity) and efficiency in forming concepts - as had been suggested in recent problem solving studies. Nor was strategy usage related to cognitive

style orientation. The experimental manipulations also failed to lead to differential performance among subjects of different grades and styles. Such an absence of relationships is puzzling if it is accurate that impulsives have less well-developed ways of approaching a learning situation. Criticisms of the experimental task itself (e.g. novelty, difficulty level) must be considered before eliminating all potential differences in concept learning ability. But, it is also necessary to consider the generalizability of this dimension (as measured by the MFF) to a task such as was employed in the present study. Block, Block, and Harrington (1974) suggested that generality of MFF performance is within a rather narrow class of cognitive tasks, and the task used in the present study may not be included in this group of tasks. No correlation was obtained between latencies on the MFF and ADM, either. These results may be yet another indication of the construct's limited value for educational situations and educationally relevant research. Of interest, however, in this study is the development of linear combinations of MFF error and latency and their use in multiple regression analyses.

Egeland and Weinberg (1976) suggested utilizing such a procedure in order to avoid the high possibility of a subject changing classification (impulsive to reflective) as is the case with traditional dichotomization procedures. This improvement in precision suggests that further exploration into its applicability in educational research is essential.

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